



UNIVERSITI PUTRA MALAYSIA

***EFFECT OF RED AND BLUE LIGHTS ON THE
STRESS RESPONSE AND GROWTH PERFORMANCE OF
JUVENILE RED TILAPIA (Oreochromis sp.)***

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**Effect of Red and Blue Lights on the Stress Response and Growth
Performance of Juvenile Red Tilapia (*Oreochromis sp.*)**

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CERTIFICATION

It is hereby certified that we have read this project paper entitled “Effect of red and blue lights on the stress response and growth performance of juvenile red tilapia (*Oreochromis sp.*)”, by Cheah Siew Siew and in our opinion it is satisfactory in terms of scope, quality, and presentation as partial fulfillment of the requirement for the course VPD 4999- Project.

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DEDICATION

To
the love in life,
the peaceful mind,
and the beauty of every single soul.



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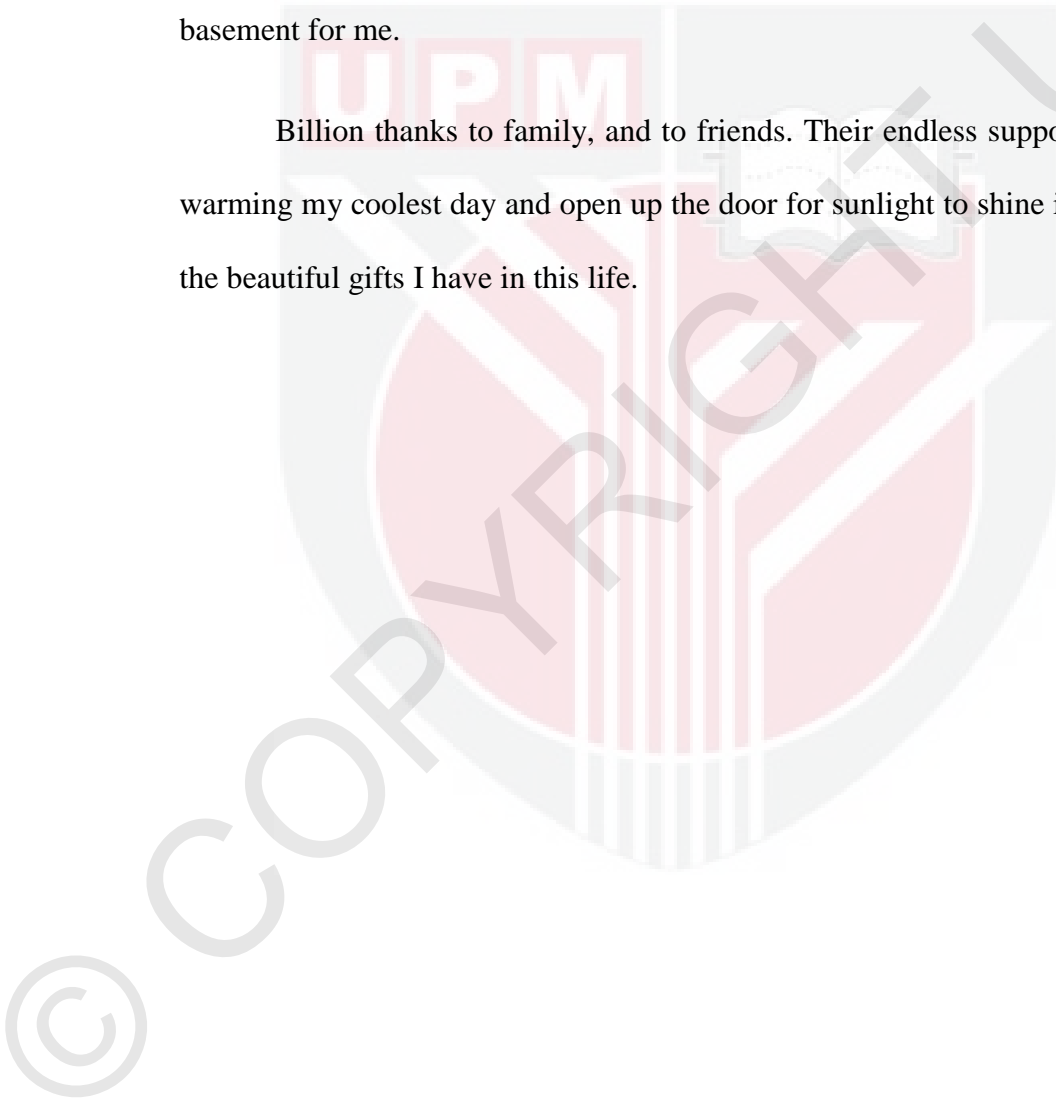
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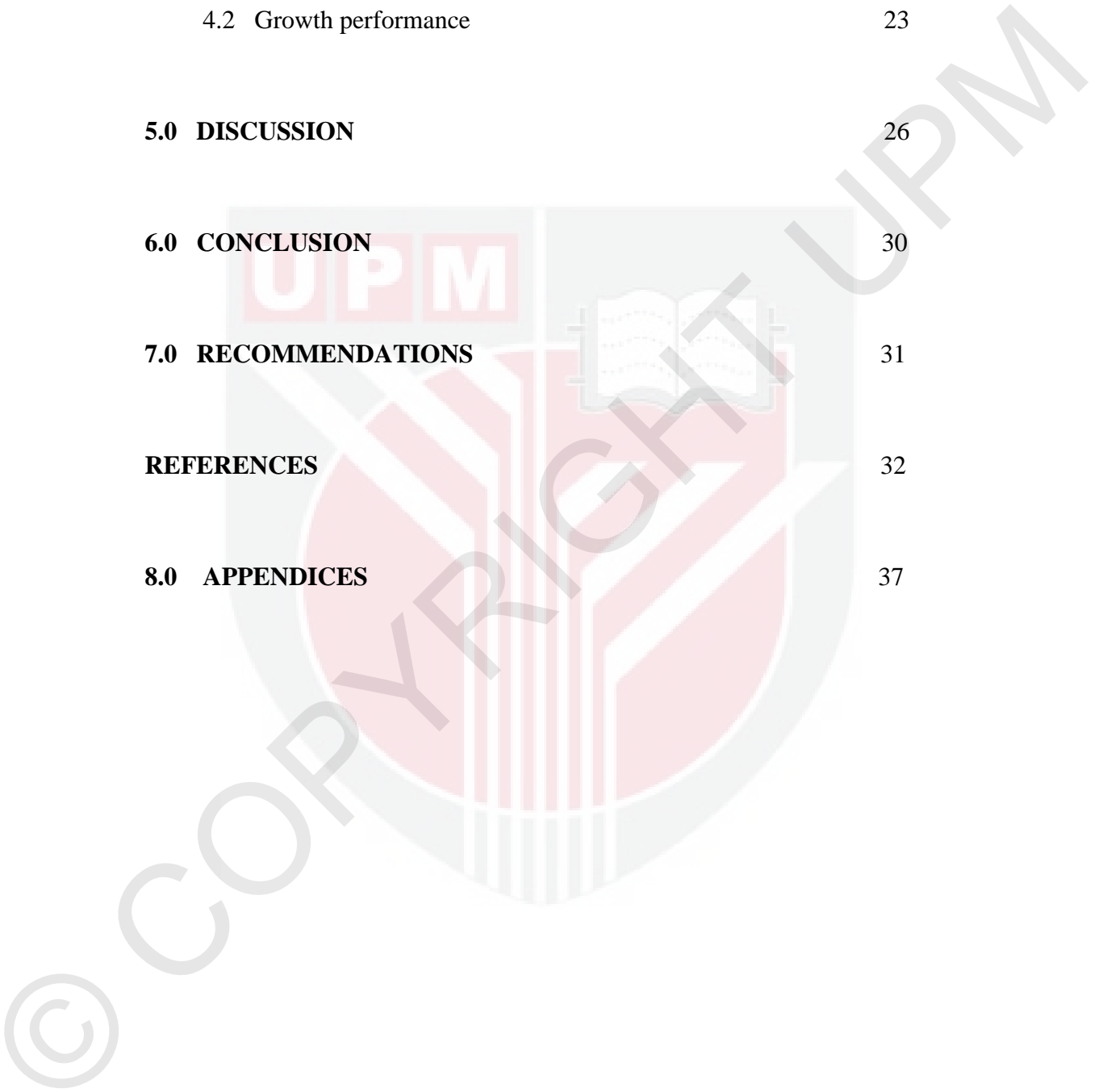
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LIST OF ABBREVIATIONS

%	percent
<	less than
°C	degree Celsius
α	alpha
$\mu\text{mol}/\text{m}^2/\text{sec}$	micromole per metre square per second
Cl	Calcium
cm	centimeter
fL	femtoliter
G	Gauge
g	gram
hsps	heat-shock proteins
K	Potassium
L	Liter
LED	Light Emitting Diode
MCHC	Mean Corpuscular Hemoglobin Concentration
MCV	Mean Corpuscular Volume
mg	milligram
mL	milliliter
mmol	millimole
MS222	Tricaine methanesulfonate
n	number
Na	Sodium
nm	nanometer
P	Probability
PCV	Packed Cell Volume
pH	potential of Hydrogen
ppt	parts per thousand
ppm	parts per million
RBC	Red Blood Cell
RCF	Relative Centrifuge Force
SEM	Standard Error of the Mean
sp.	species
WBC	White Blood Cell

ABSTRAK

Abstrak daripada kertas projek yang dikemukakan kepada Fakulti Perubatan Veterinar untuk memenuhi sebahagian daripada keperluan kursus VPD 4999 – Projek

**KESAN LAMPU MERAH DAN BIRU KEPADA TINDAK BALAS
TEKANAN DAN PRESTASI PERTUMBUHAN JUVANA
TILAPIA MERAH (*Oreochromis sp.*)**

Oleh

Cheah Siew Siew

2016

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Warna cahaya didapati mempunyai kesan ke atas tindak balas tekanan dan prestasi pertumbuhan di beberapa spesies ikan. Kajian ini menilai kesan cahaya dengan gelombang terpanjang (merah) dan gelombang terpendek (biru) pada tindak balas tekanan dan prestasi pertumbuhan juvana tilapia merah sepanjang 23 hari eksperimen. Cahaya merah dan biru ditetapkan sebagai kumpulan rawatan manakala cahaya putih ditetapkan sebagai kawalan dengan lampu dipasangkan di atas tangki yang ditutup dengan plastic yang berwarna hitam dan legap. Darah diambil daripada ikan yang dipilih secara rawak ($n = 45$) pada hari 0, 1, 3, 8, 15, dan 23 untuk menilai parameter hematologi (kiraan sel darah merah, hemoglobin, isi padu sel padat, min isi padu korpusel, min kepekatan hemoglobin korpusel,

kiraan sel darah putih, trombosit, protein plasma) dan biokimia plasma (trigliserida , glukosa, jumlah protein, albumin, globulin, dan ions- utama Na, K, Cl). Panjang badan dan berat badan juga diukur pada hari 0 dan hari 23 eksperimen untuk menilai purata ketambahan panjang badan, pertambahan berat badan, kadar pertumbuhan spesifik dan kadar penukaran makanan. Hasilnya menunjukkan bahawa tidak terdapat perbezaan yang signifikan ke atas tindak balas tekanan antara cahaya merah, biru dan putih. Cahaya biru telah menunjukkan pertambahan kepanjangan badan yang signifikan ($P = 0.002$) berbanding dengan cahaya putih walaupun parameter pertumbuhan lain seperti pertambahan berat badan, kadar pertumbuhan spesifik dan kadar penukaran makanan) adalah tidak signifikan antara rawatan tiga cahaya.

Kata kunci: Warna cahaya, merah, biru, putih, parameter hematologi, biokimia plasma, tindak balas tekanan, prestasi pertumbuhan, juvana red tilapia.

ABSTRACT

Abstract of the project paper presented to the Faculty of Veterinary Medicine in partial requirement for the course VPD 4999 – Project

EFFECT OF RED AND BLUE LIGHTS ON THE STRESS RESPONSE AND GROWTH PERFORMANCE OF JUVENILE RED TILAPIA (*Oreochromis sp.*)

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2016

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Colour of light is found to have effect on stress response and growth performance of several species of fish. This study evaluated the effect of visible light with longest wavelength (red) and shortest wavelength (blue) on the stress response and growth performance of juvenile red tilapia throughout 23 days of experiment. Red and blue lights as treatment groups while white light as control group were fixed underneath the tank lid and covered with opaque black colour plastic. Blood was withdrawn from fish chosen randomly (n=45) on day 0, 1, 3, 8, 15, and 23 to evaluate the hematological parameters (RBC count, hemoglobin, PCV, MCV, MCHC, WBC count, thrombocytes and plasma protein) and plasma

biochemistry (triglycerides, glucose, total protein, albumin, globulin, and major ions- Na, K, Cl). Body length and weight were also measured on day 0 and day 23 of experiment to evaluate the average length gain, body weight gain, specific growth rate and feed conversion rate. The result showed that there was no significant difference on stress response among the red, blue and white lights. Blue light showed significant length gains ($P=0.002$) as compared to white light although the other growth parameters (body weight gain, specific growth rate and feed conversion rate) were not significant between treatment groups (red and blue lights) and control group (white light).

Key words: Colour of light, red, blue, white, hematological parameters, plasma biochemistry, stress response, growth performance, juvenile red tilapia.

Introduction

Artificial lighting is one of the environmental factors that have been concerned in indoor intensive rearing of aquaculture. Research on lighting photoperiod, intensity and spectrum have shown some physiological changes on fish growth (Boeuf and Le Bail, 1999; Tamazouzt et al., 2000; Villamizar et al., 2014), behaviour (Marchesan et al., 2005; Owen et al., 2010) and stress response (Karakatsouli et al., 2012; Migaud et al., 2007; Owen et al., 2010). In recent years, there is increased interest to investigate the most suitable lighting spectrum in order to encourage optimum production of fish species. Red light, as the longest wavelength of visible light was found to stimulate feeding motivation in Nile tilapia (Volpato et al., 2013). Providing that stressors are kept to a minimum, red light also favoured length gain in rainbow trout (Karakatsouli et al., 2008) and yellow perch (Head and Malison, 2000). However, in a recent study on the effect of light spectrum in Atlantic cod (*Gadus morhua*) and turbot (*Scophthalmus maximus*), larvae of both species showed significantly enhanced growth under treatments of blue and green lights as compared to red light (Sierra et al., 2016). While for another study done by Karakatsouli et al. (2008), blue light was found to favour acute stress response in rainbow trout. These studies have suggested that effect of light spectrum on physiological changes could be species specific. Hence, a proper understanding of the fish reaction towards different light spectrum should be done in more fish species, especially those with commercial interest, in order to provide optimum environment factors in aquaculture sector.

In Malaysia, tilapia has grown to be one of the important freshwater fish by contributing 33% of freshwater aquaculture production in 2013 (Mazuki, 2015). With the growing interest on relationship of light spectrum and commercial fish species, this study aims to investigate the effect of lighting spectrum towards physiological changes of juvenile red tilapia, in terms of stress response and growth performance.

Activation of stress response usually indicates that the animal is responding to a challenge (Pottinger, 2008) by a suite of endocrine events (Johnson et al, 1992), followed by suite of cardio-respiratory function accompanied by mobilization of carbohydrates and lipid reserves (Pottinger, 2008), whose ultimate purpose is to protect or reestablish homeostasis.

In this study, the physical stressor: red light and blue light were exerted to the juvenile red tilapia for 23 days. At the end of experiment, blood was withdrawn to evaluate stress response in terms of hematological parameters and plasma biochemistry, especially plasma glucose. Total length and weight of each fish was also taken to evaluate the growth performance throughout the study period. Thus the objectives of this study were to:

1. Compare the effect of red and blue lights on stress response in terms of hematological parameters and plasma biochemistry of juvenile red tilapia.
2. Compare the effect of red and blue lights on growth performance of juvenile red tilapia.

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